The Science Centre as Living Laboratory

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Introduction

Techniquest, Cardiff, Wales.

On 1st May 1995, after nine years in adapted premises, Techniquest moved to its present waterfront building in Cardiff Bay. This facility, the UK's first purpose-built science discovery centre, includes a 1500 square metre exhibition area, together with a science theatre, a planetarium, a public-access laboratory, a discovery room and a computer-based information centre. Techniquest takes pride in the quality and range of its educational programmes, and the high level of reliability and originality of its exhibits – almost all designed and constructed in-house.

Visitor numbers exceed 220,000 a year. Ticket income and the turnover of the trading subsidiary, Techniquest Enterprises Limited, account for 65% of the operating budget.

In addition to its Cardiff presence, Techniquest operates an active outreach programme, both to schools in South Wales and to general public audiences more widely.

The postgraduate experience at Techniquest

The MSc 'Communicating Science' is unique among UK postgraduate courses in science communication. Run jointly by Techniquest and the University of Glamorgan, students are based at Techniquest and the science centre's facilities are their living laboratory and the focus for wide-ranging practical experiences which form an essential part of the MSc course.

The first related courses established in the UK were the MSc in Science Communication at Imperial College, and the Extramural Diploma in Science Communication at Birkbeck College. The main thrust of both of these is the

skills and understanding required to provide a bridge between the public and research scientists through print and broadcast media.

By contrast, students on the Techniquest/University of Glamorgan course develop the awareness, understanding and practical skills to communicate directly with a range of 'publics', face to face, in the informal environment of a science centre or science festival. The course is founded upon the 'reflective practitioner' model of professional practice, and mainly uses experiential learning methods. Students learn to reflect on their experience and theoretical inputs, to articulate these reflections and so gain a deeper understanding of them.

Cost/benefit analysis

From September through to the end of May, students follow eight modules that combine seminars/lectures with practical experience in and around Techniquest and the University campus.

For the first few months, students are arguably a net drain on Techniquest's human resources. The balance shifts dramatically early March: in the run-up to National Science Week and the Easter Holidays, the students themselves become innovators, and develop new tools, techniques and styles of communication. For example, as a year-group they devise, organise, deliver and evaluate an overnight camp-in on the first Friday/Saturday of Science Week. Over the four years the course has run, successive groups have refined the interactive activities offered, and honed the operational practicalities, making this event an annual landmark in the calendar of local youth groups and science clubs!

The dissertation phase of the course (June until the end of August) allows students to develop their personal research interests in the field of science popularisation. The Master's dissertation can involve designing and evaluating an activity within a science centre, or as part of a science festival. Alternatively, it might involve observation and analysis of visitors' learning in an interactive centre. Or the project can be of a more theoretical nature, critically exploring contemporary social and scientific issues in science communication. Twenty-two past students have been awarded the MSc degree, four of them with distinction.

Techniquest – a living laboratory

Paul McCrory graduated with distinction in the class of '99, submitting a dissertation entitled: 'The impact of science centre visits on students – An investigation of the professional judgement of teachers'. McCrory based his analysis on the experience both of teachers bringing school groups to Techniquest, and of those in the Bristol area who had visited the Exploratory and were looking

forward to the new facilities at **Explore@Bristol** (Explore opens 6th July, 2000 and replaces the Exploratory as Bristol's *science centre)*.

The abstract of McCrory's project appears below:

The impact of science centre visits on students – an evaluation of the professional judgements of teachers

This research investigates the outcomes of a science centre visit on students in terms of the professional judgements of their teachers. The central aim of the study was to identify different types of impact and to develop models which would encompass these reported outcomes. The secondary aims of the dissertation were concerned with how the teachers tried to integrate the visit into classroom work, and the effect of the visit on older secondary school students.

The survey sample comprised 128 teachers who had previously visited Techniquest in Cardiff or The Exploratory in Bristol. Each of these teachers completed a postal questionnaire, and 15 of them were then interviewed by telephone. A smaller national survey was attempted using notices placed in a teaching journal and on the internet, but this produced a very low response.

Although the environment, the processes and the outcomes involved in a science centre visit form an extremely complex and inter-related 'total experience' for each student, two models of the potential outcomes of a visit were developed from the testimony of the teachers. Like all such models they are only useful to the extent to which they clarify thinking and suggest alternative approaches.

The first model ('platform for formal learning') proposed that the impact of visits can be felt in two main domains – long-term cognitive outcomes (by planting memories which can be used to make connections for future learning); and short-term affective gains (increased motivation and interest in science, which can be harnessed by the teacher back in the classroom).

The second model suggested that to include all the rich diversity of outcomes mentioned by the teachers it was necessary to consider five domains – cognitive, affective, conative, behavioural and social. This model also distinguishes between gains made during the visit and those that are made afterwards. The role of the teacher in encouraging these longer-term outcomes is crucial.

Both models were based on an acceptance that given the nature of the environment of a science centre, the possible outcomes of a visit need to be considered in a different framework than those used to evaluate formal education. The freedom of the informal environment will lead to outcomes that are generally not predetermined and are much more diverse that those of formal education.

For the science centre field as a whole, the gain from this project is considerably greater than one more MSc-qualified professional: the 5-domain model has important implications for exhibit and programme development and evaluation, and also in terms of how teachers can maximise the impact of the visit in the cognitive, affective, conative, behavioural and social domains.

The dissertation's final 'Recommendations' section advocates that exhibition and education programmes be developed and presented in such a way as to encourage particular types of outcome. For example:

- Encouraging affective and conative outcomes can support and even encourage cognitive gains though the use of intrinsic motivation, enjoyment, humour, and variety
- However, concentrating on cognitive outcomes and very structured visits may limit or even negate any affective or conative outcomes ('the worksheet phenomenon')
- The use of trained Explainers can increase the quantity and quality of the connections that children make during a visit without significantly affecting their enjoyment
- Science centres and schools should provide more opportunities to allow students to follow up their interest in science, e.g. website activities, science clubs, science magazines, library books, sources of information about science in the news, practical follow-up activities for students. These are all activities that give opportunities for the affective and conative gains from the visit to combine in producing real behavioural changes and increased involvement with science after the visit
- Science centres should attempt to design exhibits and programmes to encourage co-operative learning and teamwork skills – most students are very keen to engage in group activities.

These findings are by no means restricted to the Cardiff or Bristol experiences. They are equally applicable to the policy makers and developers of exhibits and programmes in modern interactive centres worldwide.

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